CHAPTER 2

REVIEW OF LITERATURE
The main aim of this study was to find out the effective control measures for the management of betelvine Phytophthora diseases. The relevant work carried out earlier is therefore reviewed as under:

On account of the fact that the antibiotic compounds may be readily absorbed and quickly translocated all over the plant body, they may be systemic in nature and gain preference over conventional fungicidal treatment which mainly have local effect at the site of application. Other advantages of such agents would be less washing off by rain and upon translocation in the plant, the protection of untreated part or new growth. Aside from a systemic action, antibiotics might be of great value in cases where the commonly used chemicals may produce injurious side effects on the crops or may be toxic for human being or animals. The antibiotic are the compounds comprising a large group of microbial metabolites which are mainly characterised by their selective antimicrobial spectra. Antibiotics are known to have chemotherapeutic importance and may control plant diseases by action on the parasite or on the host directly or after undergoing transformation within the host plant. Several factors may affect mode of their disease controlling action such as toxic activity of the antibiotics "in vitro" against plant pathogens, the rate of their absorption and transport in the host plant or in the antibiotic after uptake.
The word "antibiosis" was first used in 1889 by Vuillemin. Its meaning was adopted in the same year by word (1889) to refer the microbial antagonism as the converse of symbiosis. The term antibiotic was first employed by Waksman et al. (1942) to refer to the substances produced by microorganisms which are antagonistic to the growth of other microbes. Benedict and Lengyel (1947) suggested broadening of the definition to include inhibitory substances to plant or animal origin. Vaderbank et al. (1954) in reviewing the historical background of the problem suggested that an antibiotic be defined as a compound possessing inhibitory i.e., static, degenerative, lysing or killing activity for vegetable and animal microorganisms such as viruses, rickettsiae, bacteria, actinomycetes, fungi, algae and protozoa etc.

The discovery of most famous antibiotic, Penicillin by Fleming (1929) and the work of Chain et al. (1940) established penicillin as the most potent anti-infective agent. This was followed by successive contributions by Waksman and his associates leading to the discovery of streptomycin and other new potential antibiotic compounds (Waksman and Schtz, 1945; Waksman et al., 1946; Waksman and Lechevalier, 1953; Waksman and Lechevalier, 1962). Subsequently thousands of antibiotics and their synthetic analogues have been discovered. Antibiotics have shown their most remarkable performance in the field of
medicines. Besides this, a good number of antibiotics have also been found to be multifarious in use especially in plant disease control, food preservation, poultry feed, preservation of semen, virus, vaccines and similar biological materials.

Based on the concept of microbial antagonism due to antibiosis, a large number of antibiotic producing microorganism including mainly antinomycetes, bacteria and fungi and/or their metabolites have also been employed as potential agents for the control of various soil borne plant diseases (Snyder, 1960; Garrett, 1965; Lebon, 1965; Baker, 1968; Chang and Kommedahl, 1968; Saksena, 1972; Soni et al., 1972; Soni, 1973; Chourasia, 1976; Sharma et al., 1981)

Besides, some of these metabolites (antibiotics) are known to cause very strong inhibitory action at the particular step(s) of metabolic pathway and these are used as research tools in research laboratories. Streptomycin has been proved very useful for the investigations of various aspects of microbial genetics. Chloramphenicol, Cycloheximide and Puromycin are effectively used for the study of protein synthesis for nucleic acid metabolism, however, actinomycin D is of prime importance while Actinomycin and oligomycin are employed for investigation of respiratory metabolism.
Antibiotics may also exert many pronounced physiological effects on plants. They may effect plant growth and development like cell division, cell enlargement, cytodifferentiation and organogenesis in callus tissues, stem, leaf, root and fruit growth, flower, initiation, shoot senescence, leaf abscission and fruit ripening, bud and seed dormancy, relative growth and response to water stress etc. (Brian et al., 1949; Brian, 1951; Wright, 1951; Gottelieb et al., 1950; Wallen & Skotheim, 1951; Brian, 1957; Shrinivasan, 1975 and Jain, 1981).

However, besides other uses, antibiotics are most widely used for the control of various bacterial, viral, mycoplasmal and fungal diseases of plants.

A large number of antibiotics have been tried for the control of various plants diseases. The important antibiotic use for the control of plant diseases are Streptomycin, Tetracycline, Griseofulvin and Cycloheximide and Aureofungin etc. (Bajaj and Ghosh, 1975). As a matter of fact the advent of antibiotic era had raised the hopes that antibiotics provide in which much awaited chemotherapeutants for the control of plant diseases although so far as fungal diseases are concerned, this expectation has been fulfilled only to a limited extent.

Amongst antifungal antibiotics, Nystatin, has been used more successfully by many workers for the control of
anthracnose of beans and downy mildews of cucumber (Ark and Thompson, 1957) and as seed treatment against stripe disease of barley (Vir and Raychaudhuri, 1968) and as post harvest dip against peach, brown rot and anthracnose of banana (Ananthanarayana & Seshadri, 1965). Shrivastava (1985) also observed their antifungal effect against Phytophthora disease of "Pan".

Other antifungal antibiotic griseofulvin has however been found useful in the plant disease control only to a limited extent. It has been found effective against certain mildews including powdery mildews of roses (Ark and Thompson, 1957), and on cucumber (Sowell, 1957). Other diseases which have been controlled by foliar sprays of Griseofulvin are Botrytis cinerea on lettuce (Webb, 1958), B. tulipae on tulips (Valaskova 1958), Sclerotinia fructigena and S. maydis on apple trees (Rhodes, 1962; Byrde, 1959), Cercospora beticola on beets (Ghildini and Alghisi, 1960), Phyllosticta coffeicola on coffee (Rodriguez et al., 1957) and Phytophthora parasitica var. Piperina on "pan" (Shrivastava 1985).

Amongst various antibacterial compounds Streptomycin and Tetracycline derivatives have been found to be very efficacious for the control of many bacterial and some fungal diseases. The most successful application of Streptomycin was against fire-blight disease, caused by
Erwinia amy vorora (Ark, 1955). Streptomycin also proved to be active against walnut blight caused by Xanthomonas Juglandis (Miller, 1959). There are numerous reports on more or less successful results with foliar application of Streptomycesin against bacterial diseases caused by the species of the genera Erwinia, Pseudomonas, Xanthomonas and Bacterium. These include black leg of potatoes, stewart's disease of sweet corn bacteria wilt of cucumber, bacterial blight of celery, common and fuscous blight of beans, bacterial blight of soyabeans and black chaff of wheat (Goodman, 1959; leaf rot of philodendron (Tanner and Becsch, 1958) blast and bacterial canker of stone fruit (Boyd and Paton, 1958), bacterial spot of peach, plum and apricot (Klos, 1958; Verneau and Rosa, 1958) citrus canker (Rangaswami et al., 1959 angular leaf spot of cucumber (Stanek, 1958; Stanek and Wasserbauer, 1960), halo blight of beans (Afanasjef and Sharp, 1958), Wild fire of tobacco (Hitier and Izard, 1960; Shaw et al., 1959, black rot of crucifers (Klisiewiz and Pound, 1961); soft rot of lettuce, (Win Free et al., 1958), bacteria spot of pepper and tomato (Chandler, 1958; Sowel, 1959; Stall, 1959; Thayer and Stall, 1961; Stall and Thayer, 1962); bacterial leaf spot of wheat and barely (Stanek et al., 1959); black arm disease of cotton (Balchandran et al., 1960), and leaf blight of corn (Sabet, 1956).

Besides being very useful against bacterial plant disease, Streptomycin may also be very effective against
diseases caused by certain fungi, mainly phycomycetes such as late blight of tomatoes and potatoes (Crosse et al., 1960; Hodgson, 1958). Maier (1960) reported the efficacy of Streptomycin against hop downey mildew (*Pseudoperenospora humuli*): spraying of Streptomycin on young hop shoot not only eradicated the fungus but also protected the hop plant against subsequent infection. Streptomycin may also be effective against powdery mildews of roses (*Sphaerotheca Pannosa*). Crossley (1960) showed that in greenhouse experiment, a Streptomycin copper chelate was found to be six times active as Streptomycin sulphate against tomato late blight. A mixture of Streptomycin and 8-Hydroxy-Quinoline sulphate as a combination has been found successfully chemotherapeutic for black leg disease of geraniums (Stoddard, 1957). Zaumeyer (1956) showed that tomato seedlings were effectively protected against infection by *Phytophthora infestans* with Streptomycin and Oxytetracycline. He also showed that control of downey mildew caused by *P. Phaseoli* of lima beans was obtained with Streptomycin formulation under greenhouse conditions. Anderson (1956) reported that the Streptomycin was able to reduce damage caused by a number of downey mildews, such as blue mold of tobacco seedling caused by *Perenospora tobacina* and mildew of broccoli caused by *P. Parasitica*. Iyengar (1966) also reported the antifungal activity of Streptomycin. According to him the growth of *Penicillium chrysogenum* therm, was marked inhibited by Streptomycin.
sulphate both in seed and production stages. Richards et al. (1966) reported that Streptomycin at low concentration can completely inhibit the growth of a variety of yeasts during the incubation period.

Tetracyclines being broad spectrum in nature also act against a wide range of gram positive and gram negative bacteria and certain fungi. A number of Tetracycline preparation including mainly Tetracyclin, Aureomycin and Tetracycline have been used for the control of various plant diseases.

Oxytetracycline and Chlortetracycline were found to be absorbed by several plants, but not by cucumbers (Darpoix et al., 1958). After application of Chlortetracycline and Oxytetracycline to the roots of tomatoes, control of tomato canker was obtained (Kruger, 1961), Oxytetracycline after root application destroyed 5 to 10 day old tumors on tomatoes (Korenyako and Koveshnikov, 1960), and also reduced crown gall of pear and cherry nursery trees (Cole, 1959; Deep, 1958). A thirty minute dip of root pruned cherry seedlings in a solution of Oxytetracycline eliminated incipient infections, while about 20% of the control plant showed crown gall. Klisiewicz and Pound (1961) reported about the chemotherapeutic action of Tetracyclines in seed disinfection.

Some reports also reveal the activity of Tetracyclines against viral diseases. Multiplication of
tobacco mosaic virus was somewhat reduced in leaf discs which were floating on solution of Chlorotetracycline and Tetracycline (Shimomura and Hira, 1959).

Tetracycline has recently been found to be very effective against plant diseases caused by mycoplasmas. An injection of a concentrated solution of Tetracycline or Oxytetracycline into tree trunks offers possibilities of using these compounds for the control of peach and pear decline, coconut palm yellows and citrus greening etc. (Necoy, 1972; Nyland and Moller, 1973; Capoor and Thirumalachar, 1973). Interestingly Tetracyclines also appeared to be useful against certain fungi including Phytophthora infestans and Pythium aphanidermatum (Bonde, 1953; Sharma and Wahab, 1972): Chaurasia (1976) screened a large number of organic and inorganic substances including phenolic compounds metabolically inhibitors, fungicides, antibiotics for their relative efficacy and after many tests and trials a good deal of disease control of 'Pan' was observed by dipping the betelvine cuttings in a 1% solution of Streptomycin for about 10 minutes before planting and subsequent spraying of the betelvine plants with 1% Bordeaux mixture twice a month (Vyas and Chaurasia, 1979). Interestingly, however, the experimental results of primary screening tests carried out by Chaurasia (1976) also revealed the potential fungitoxic activity of a good number of other antibacterial and a few antifungal antibiotics against betelvine Phytophthora.
Shrivastava and Vyas (1983) reported the efficacy of tetracycline against leaf rot of 'Pan' (Phytophthora Parasitica var. Piperina).

Shrivastava (1985) also screened a large number of antibacterial and antifungal antibiotics viz. Gentamicin, Kancin, Neomycin, Streptomycin, Aureomycin, Doxycycline, Hostacycline, Ledermycin, Reverin, Terramycin, Penidure La 12, Ampicillin, Amoxycillin, Ceporan, Sporidex, Chloromycetin, Cyclorin, Erythomycin, Rifucilin, Aureofungin, Mycostatin, Grisonin, Elkosin, Orisul, Sulfadiazene, Urolocusil, Daraprim, Primaquin, Risochin, Bistepen, Chlorostrep and other substances including glucose, amino-acids, ions, vitamins, cholesterol for their relative efficacy both in vitro and in vivo for the control of betelvine Phytophthora. Observed a good deal of efficacy of streptomycin, Kanamycin, Gentamicin, Ledermycin and Doxycycline for the control of Phytophthora disease of 'pan' (Shrivastava, 1985).

The influence of antibiotics in the inhibition of mycelial growth of Botryodiplodia theobromae was studied by Atri (1980). Inhibition of pectolytic enzyme production by Rhizopus nadosus and Phytophthora nicotianae in presence of Amoxycillin, Raficillin and Chloramphenicol has also been observed (Sexana, 1982).

Chopra et al., (1989) reported the inhibition of cell wall degrading enzymes of three isolates of A. niger by
various antibiotics. Khare (1992) and Thaker (1992) also recorded the inhibition of pectolytic and cellulolytic enzymes of Phomopsis sp. and F. moniliforme, respectively by various antibiotics.


In recent past Homoeopathic drugs have been shown to have a great potential safe in environment natural, harmless, extremely cheap easy to handle and economical agent for the control of plant diseases, homoeopathic drugs are employed in ultra high dilutions and in potentized form.

The innovative idea that homoeopathic drugs could be put to use for the control of plant diseases, came to lime light when idris for the first time in 1967 presented his findings at the international Homoeocongress held at New Delhi. Antifungal properties of homoeopathic drugs have also been reported by Khurana (1968), Verma et al. (1969), Khanna and Chandra (1976, 1977 a, b, 1978), Singh and Gupta (1980, 1981), Dua and Atri (1983) and Shrivastava and Kushwaha (1984).

Antifungal properties of Thuja occidentalis and Arsenicum album against several viral and fungal pathogens
"in vitro" and "in vivo" have been reported by Khurana (1968, 1980), Khanna and Chandra (1976, 1977, a.b. 1978), Goswami and Das (1980), Singh et al. (1980).

Khanna and Chandra (1976), Singh and Gupta (1981), Dua and Atri (1983), Shrivastava and Kushwaha (1984) reported antifungal property of several homoeopathic drugs against the mycelial growth of various pathogenic fungi viz, Thuja occidentalis against *Alternaria Solani*, *Apis mellifica*, *Arsenicum album*, *Biatta orientalis*, *Chenopodium anthelminticum* and sulphur against *Botryodiplodia Theobromae* and *Apis mellifica*, *Arsenicum album*, *Chenopodium anthelminticum*, *Lycopodium Clavatum* and Thuja occidentalis against *Rhizopus nodosus*. However Thuja occidentalis and *Arsenicum album* were found effective against all the pathogen.

Khanna and Chandra (1976) studied the effect of homoeopathic drugs against certain pathogenic fungi. They found that some of the potencies (between 1-200) of *Arsenicum album*, *Biatto O.*, *Kali I.*, and Thuja O. were antimerminatorial to the spores of 4 isolates of *A. alternata*. They further reported (Khanna and Chandra 1977a) that various potencies of the same drugs either totally prevented spore germination or mycelial growth of *Pestalosia psidii*, the incitant of guava fruit rot.

Khanna and Chandra (1982) investigated the effect of Zincum sulphuricum potencies 1 and 2, Thuja occidentalis
potency 87, phosphorus potency 35. Arsenicum album potency 1 and kali iodatum. Potency 149 on the rate of respiration and permeability of the walls of germinating spores. mycelial growth of Fusarium roseum link was studied.

Singh and Singh (1983) observed the inhibition of growth and aflatoxin production by 10 homeopathic drugs against A. parasiticus. Hepar sulphur and all the other 9 drugs inhibited aflatoxin producing and checked fungal growth. Singh (1983) tested 4 homoeodrugs Bacilinum, fagopyrum, petroleum and Sepia against the radial growth and dry mycelial weight of 4 Keratinophilic fungi.

Dua and Atri (1983) observed that the inhibitory responses of five homeopathic drugs viz. Arsenicum album, Blatta orientalis, Cina, Lycopodium clavatum, Thuja occidentalis against Alternaria solani and Botryodiplodia theobromae Arsenicum album appeared to be more remarkable against the mycelial growth of A. solani.

Kehri and Chandra (1986) investigated the efficacy of certain homeopathic drugs against Botryodiplodia rot of guava both "in vitro" and "in vivo" and reported that Arsenicum album was found to completely suppress the spore germination of the pathogen and check the rotting of the fruits.

Dua (1986) studied in detail the effect of 19 homeopathic drugs at different potencies against the radial
growth, lesion diameter and enzyme production in case of *Alternaria solani*, *Botryodiplodia theobromae* and *Rhizopus ncdosus* causing infection on tomato, apple and brinjal fruits, respectively.

Shrivastava and Kushwaha (1984) recorded the inhibition of some skin pathogens, like *Microsporium fulvum* and *M. gyroseum* by homoeopathic drugs.

Kachhwaha (1993) also showed the efficacy of five homoeopathic drugs viz *Apis mellifica*, *Arnica montana*, *Arsenicum album*, *Calendula officinalis* and *Ipecacuanha* of 6, 30, 200 and 1000 potency against *C. granati* and *G. candidum* fruit rot diseases of Alubukhara and Grape.

Khare (1994) reported inhibitory effect of six homoeopathic drugs viz. *Arsenicum album*, *capsicum*, *cina*, *cocculus indicus*, *Gelsemium* and *Notram muraticum* each with 6, 30, 200 and 1000 potencies against chilli rot caused by *Colletotrichum capsici*.

The systemic study of higher plants for their antifungal activity is of comparatively recent origin. Only a few plants possessing anti-microbial activity have been tried for the control of plant diseases. Unfortunately, such studies were of preliminary nature but indicated the possibility of using plant extracts in plant disease control though plants have been used for antibiotic preparation
since time immeorial. Reviews pertaining to such type of studies have earlier been published by Bendict and Langlykke (1947), Bailey and Cavallito (1948), Skinner (1955), Nickell (1959), Ark and Thompson (1959), Tokin (1960), Gera et al. (1963), Kovacs (1964), Thapliyal and Nehe (1967), Fawcett and Spencer (1969), Dekker (1969), Fawcett and Spencer (1970), Marinibettoio (1970), Dekker (1978) and Mahadevan (1982). Most of these chiefly deal with antibacterial investigations. However, in the present treatment only antifungal investigations have been considered, with respect to both "in vitro" and "in vivo" studies.

The infected plants of Picinus communis were treated both locally and by root application with the aqueous extracts of garlic, radish and tulip and it was observed that 1:3 dilution of garlic increased the number of healthy plants from 3 to 69%, while the extracts of radish and tulip were ineffective (Corberi, 1958).

At the Institute of microbiology, peking, 312 plant extracts were tested for the control of several plant diseases 80% control of Phytophthora infestans (on potato) was obtained with extracts from 20 plants, Oryza japonica and Lycoris radicata were most effective and as promising as preparations of copper sulphate (Anonymous, 1959).

Ark and Thompson (1959) controlled downy mildew of Cucumber (Pseudoperonospora cubensis), downy mildew of
radish (*Peronospora parasitica*), cucumber scab (*Cladosporium cucumerinum*) early blight of tomatoes (*Alternaria solani*), brown rust of stone fruits (*Monilinia fructicola*) and angular leaf of cucumber (unspecified) by spraying 1-20% aqueous extracts of garlic. They also controlled *P. parasitica* by dust formulation of garlic powder.

Tokin (1960) reported the control of rose rust, soft rot of carrots, storage and transit rot of apples, barley smut and seed brone diseases of cotton by the extract of *Allium cepa*. Aqueous infusion of dry onion scales was found effective for the control of white rot (*Sclerotinia sclerotianum*) and grey rot (*Botrytis cinerea*) of vegetable in storage (Nikolaeva, 1961).

Kovaces (1964) observed that onion juice protected flax seed from infection caused by *Fusarium lini* and lettuce seed from *Rhizoctonia solani*. He further observed that *Penicillium italicum* infection of oranges was greatly reduced by the extracts of garlic and horse-radish.

Valle (1957) obtained a highly active antifungal extract by macerating the leaves of *Aquila* on pea agar medium against *Phytophthora infestans* 1 g/ml.

Abdullaeva (1959, 1962) tested 400 plants for their phytocidal properties and recorded that volatile fractions as well as saps of *Allium sativum* and *A. cepa* were toxic to *Verticillium dahliae*, *F. oxysporum* and
Rhzoxctonia sp. however, garlic was found to be more effective than onion.

Kovacs (1964) reported that 1:1000 concentration of expressed juice of onion was able to reduce the spore formation in Phytophthora infestans.

Gupta and Banerjee (1970) screened 150 plant species against Trichophyton rubrum and A. niger and recorded that only Curcuma zedoaria and Brassica sp. were active against the test fungi.

Mishra and Dixit (1976) reported that crude extract of Allium sativum L. completely inhibited the growth of 18 fungus sp.

Singh et al., (1980), recorded that the aqueous extracts of leaf trunk, fruit, pulp of Azadiracta indica inhibited the growth of some soil-borne pathogens viz. F. axysporum, F. sp. ciceri, R. solani, S. rolsii and S. sclerotium. Whitfield et al. (1981) reported that volatile consitutents of roots of Acacia pulchella was toxic to Phytophthora cinnamomi.

Choshe et al. (1984) screened 49 indigenous plants and reported toxicity of 10 plants against Phytophthora, Ceratocystis, Phovna, Alternaria, Fusarium and Sclerotinia. Phoma, Phytophthora Carotivora and some other fungus.
Ahmad et al., (1984) reported that bulb extract of garlic (*Allium sativum*) at different concentrations inhibited the spore germination as well as mycelial growth of *Macrophomina phaseolina*, *Botryodiplodia theobromae* and *Colletotrichum corchori*.

Deacon and Mitchell (1985) reported that roots of oat (*Avena sativa*) and grass (*Arrhenatherum elatius*) attract and caused lysis of zoospores of *Phytophthora Cinnamomi*. The lytic compounds was thought to be a saponin and named arvencin. It prevented cysts wall formation by Zoospores. Tripathi et al. (1985) reported that the leaves of *Ocimum Gratissimum* contain strong volatile fungitoxicity compounds which are effective against *A. alternata*, *C. Capcici* and *S. rolfsii*.

Shami et al., (1985) reported that the garlic clove juice (GA) inhibited spore germination and mycelial growth of *Fusarium oxysporum f. sp. niveum*.

Asthana et al. (1986) screened the leaf extract of *Ocimum adscendens* against *Aspergillus flavus*.

Dwivedi and Dubey (1986) observed hydrodistillate of *Azadirecta Indica* and *Eucalyptus globulus* possess fungicidal effect against *Macrophomina phaseolina*.

Singh and Dwivedi (1987) reported that the hyphal dry weight and sclerotia production was significantly
reduce by bulb and leaf extracts of garlic and onion, lead
extracts of *Aradirecta indica*. Rhizome extracts of ginger
and some other parts of some other plants.

Chalfoun and Carvalho (1987) reported that
mycelial growth of *Gibberella Zeae* (*Fusarium graminearum*)
was inhibited by garlic extracts of 8000 ppm and 10,000 ppm.

Assadi and Behrooz (1987) reported that the garlic
extracts were more effective than those from onion against
*F. solani*, *F. oxysporum*, *F. acuminatum* (*Gibberella
acuminata*).

Bunny and Tippett (1988) reported that exposure to
volatiles from the stem resin of *Pinus radiata* and
*P. Pinaster* caused a reduction of radial growth of mycelium
of *Phytophthora Cinnamomi*, *P. Ciricola*, *P. megasperna* and
*P. nicotianae*.

Grewal and Grewal (1988) reported that water
extracts, prepared from green leaves of *Azadirecta indica*,
*Chrysanthemum indicum*, *Iagetes erecta* and seeds of
*Azodirecta indica*, displayed different fungicidal effects
on 22 test fungi.

Hercer *et al.* (1988) demonstrated that the aqueous
and ethanolic leaf extracts of *Reynoutria sachalinensis*
controlled *Phytophthora infestans* on potato and *F. graminis*
on wheat.
Chauhan and Singh (1991) observed the volatiles of garlic (*Allium sativum* L.), onion bulb (*A. cepa* L.) ginger rhizomes (*Zinziber officinale* Roscoe), leaves of Tulsi (*Ocimum sanctum* L.) and basil (*O. basilicum* L.) inhibition the germination of zoospores of *Phytophthora drechsleri*. The volatiles from garlic and onion bulb inhibited the spore germination at 5000 and 10,000 ppm, respectively.

Singh *et al.* (1991) reported that the fresh rhizome extract of ginger (*Zingiber officinale*) at 20,000 ppm gave the best control of powdery mildew of pea (*Pisum sativum*) under field condition.

Patil *et al.* (1992) reported inhibition of spore germination in *Rhizopus arrhizus* and *Botryodiplodia theobromae* by 10% water extract of *Ocimum sanctum* (Tulsi) which also reduced protein content and activities of pectinolytic and cellulolytic enzymes of these fungal pathogens.

Kachhwaha (1993) showed that the efficacy of 7 leaves extracts viz. *Thuja orientalis*, *Mentha viridis*, *Ocimum sanctum*, *Aegle marmelos*, *Azadirachta indica*, *Murraya Koenigii* and *Piper betle* and stems of 4-plants *Zinziber officinale*, *Allium sativum*, *Allium cepa* all at 10,25, and 50% concentration and *Curcuma domestica* of 5,10 and 20% concentration against Alubukhara and Grape fruits rot *C. granati* and *G. candidum*. 
Sarvamangala *et al.*, (1993) reported *Azadirachta indica*, *Calotropis gigantea*, *Catharanthus roseus*, *Eucalyptus* sp., *Parthenium hysterophorus* and *Pongamia pinnata* was tested against *Cerotelium fici* and *Cercospora moricola* causing leaf rust and leaf spot diseases in mulberry, respectively. *A. indica* was more effective inhibiting spore germination of *C. fici* by 91.2 per cent, whereas extracts of *Eucalyptus* sp. and *C. gigantea* proved highly toxic to *C. moricola* inhibiting conidial germination by 91.5 and 91.3 per cent, respectively. Under field conditions also, leaf extracts of *Eucalyptus* sp. and *C. gigantea* showed promising results reducing leaf spot disease incidence by 63.6 and 56 per cent, respectively. Extract of *P. pinnata* showed poor fungitoxicity against both the fungi tested.